Infection Control

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Objectives

- Recognize the importance of infection prevention in healthcare facilities
- Review the basic principles of infection prevention

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History of Infection Control Precautions in the United States

- 1877 Separate facilities
- 1910 Antisepsis and disinfection
- 1950-60 Closure of Infectious disease and TB hospitals
- 1970 CDC "Isolation Techniques for use in Hospitals"

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History of Infection Control Precautions in the United States

- 1983 CDC Guideline for Isolation Precautions in Hospitals

  (Disease-specific and category-based precautions including blood and body-fluids)
- 1985 Universal Precautions
- 1987 Body Substance Isolation

  (Mostly focused on worker protection)

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History of Infection Control Precautions in the United States

- 1996 Publication of CDC/HICPAC revised guidelines

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Standard Precautions

- Constant use of gloves and handwashing (plus face-shields, masks or gowns if splashes are anticipated) for any contact with blood, moist body substances (except sweat), mucous membranes or non-intact skin.

- Risk assessment

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Transmission-based Precautions

Used in addition to Standard Precautions

- Airborne
- Droplet
- Contact

➢ *Laboratory and procedure-specific safety*

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Airborne Isolation

For infections spread by particles that remain suspended in the air (TB, measles, varicella, and variola).

- Negative pressure room.
- Surgical mask on patient.
- N-95 mask for personnel inside negative pressure room.
- Isolation room air should not be recirculated in the building.
- Exhaust air away from people, e.g., off the roof.

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Droplet Precautions

For infections spread by large droplets generated by coughs, sneezes, etc. (e.g., Neisseria meningitidis, pertussis, influenza).

- Face shield or goggles, and a surgical mask (not N-95) are worn to prevent droplets reaching the mucous membranes of the eyes, nose and mouth when within 3 feet of the patient.
- Patients should be separated by 3-6 feet, or be grouped with other patients with the same infection/colonization status.
- Patient should wear a surgical mask when outside of the patient room.
- Negative pressure room is not needed.

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Contact Precautions

For infections spread by direct or indirect contact with patients or patient-care environment (e.g., shigellosis, C. difficile, MRSA).

- Limit patient movement.
- Private room or room shared with patients with the same infection status.
- Wear disposable gown and gloves when entering the patient room.
- Disposable gown and gloves should be removed and discarded inside the patient room.
- Wash hands immediately after leaving the patient room.
- Clean patient room daily using a hospital disinfectant, with attention to frequently touched surfaces (bed rails, bedside tables, lavatory surfaces, blood pressure cuff, equipment surfaces).
- Use dedicated equipment if possible (e.g., stethoscopes)

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Transmission-based Precautions

- Droplet and airborne transmission
  - Infectivity
    - time/distance vs environmental factors
  - Obligate or Preferential (predominant mode)
  - Opportunistic

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Transmission-based Precautions

- Bio-aerosol sources:
  - Patients
  - Aerosol-generating procedures
  - Environmental sources

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Survival in transit:

- Organism factors
- Environmental factors
  - Time / Distance
- Droplet size?

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"5 microns"

- Diameter related to unique pathogenesis of pulmonary *Mycobacterium tuberculosis* infection
  - Terminal alveolar deposition
  - "Obligate" inhalational transmission
- Much larger particles can float and are inhaled.
- Most inhaled particles are not infectious.
- Most respiratory pathogens do not require terminal alveolar deposition, but infect the upper respiratory mucosa.
- "Opportunistic" inhalational transmission?

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Scientific gaps regarding inhalational infection transmission:

1. Relationship between particle science and infectivity:
   - Time / Distance factor for specific pathogen types
   - Ability of masks and respirators to prevent infection
     - Relative contributions of fit and filtration
2. Risk of infection related to used masks and respirators
   - Direct contact, re-aerosolization

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Scientific gaps regarding inhalational infection transmission:

- Research Agenda
  - Aerobiology
    - Organism-specific measurements
    - Environmental variables
    - Substrate variables
    - Procedural factors

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Microbial reservoirs:

How are infections transmitted?

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InfectionTransmission

To cause an infection, a pathogenic organism must:

- Leave original host
- Survive in transit
- Be delivered…
- …to a susceptible part of a host
- Escape host defenses

Multiply and cause tissue damage

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InfectionTransmission

- Symptoms (cough, bleeding, diarrhea)
- Clinical specimens
- Incubation period

- Leave original host
- Survive in transit
- Be delivered…
- …to a susceptible part of a host
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Multiply and cause tissue damage

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InfectionTransmission

Leave original host

Survive in transit

Be delivered…

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Escape host defenses

Multiply and cause tissue damage

Organism-specific:
- *viral envelopes*
- *spore formation*
- *metabolic factors*

Environmental:
- *humidity*
- *temperature*
- *surface type*

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InfectionTransmission

Leave original host

Survive in transit

Be delivered…

…to a susceptible part of a host

Escape host defenses

Multiply and cause tissue damage

Air
-direct splashes
- inhalation
**mechanical aerosols*

Surfaces
-equipment
-environment of care

Water

Hands

CDC

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Hands

- *containment*
- *air handling*
- *vacuum shrouds*

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Hands

- *containment*
- *air handling*
- *vacuum shrouds*

- *device reprocessing*
- *environmental hygiene*
- *surface materials*
- *sharps handling*

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Hands

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- *air handling*
- *vacuum shrouds*
- *device reprocessing*
- *environmental hygiene*
- *surface materials*
- *sharps handling*
- *gloves*
- *hand hygiene*

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InfectionTransmission

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Multiply and cause tissue damage

- Hands
- PPE

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InfectionTransmission

Leave original host

Survive in transit

Be delivered…

…to a susceptible part of a host

Escape host defenses

- Immunization
- Post-exposure prophylaxis
- Wound care

Multiply and cause tissue damage

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Emerging Pathogens:

- Human exposure to new environments
- Changes in animal or vector exposure
- New procedures (e.g., medical, cosmetic)
- New populations at risk
- New social factors (e.g., crowding, nursing homes)

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Emerging Pathogens:

- Unexpected
- Unfamiliar
- Undiagnosed

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Emerging Pathogens:

- Unexpected
- Unfamiliar
- Undiagnosed

- Reactive responses – late
- Routine practices - essential

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Routine practices

- Arrival assessment
  - Triage and waiting area placement
- History taking
  - Syndromic routing
  - Diagnostic evaluation

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Routine practices

- Standard Precautions
  - Based on risk assessment
  - Prevention of anticipated exposures
  - Combination of procedures and protective equipment

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Routine practices

- Personal hygiene
  - Work habits and reflexes
  - Attention to manipulating equipment and removing PPE
- Environmental hygiene
- Occupational health

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The role of personal protective equipment (PPE)

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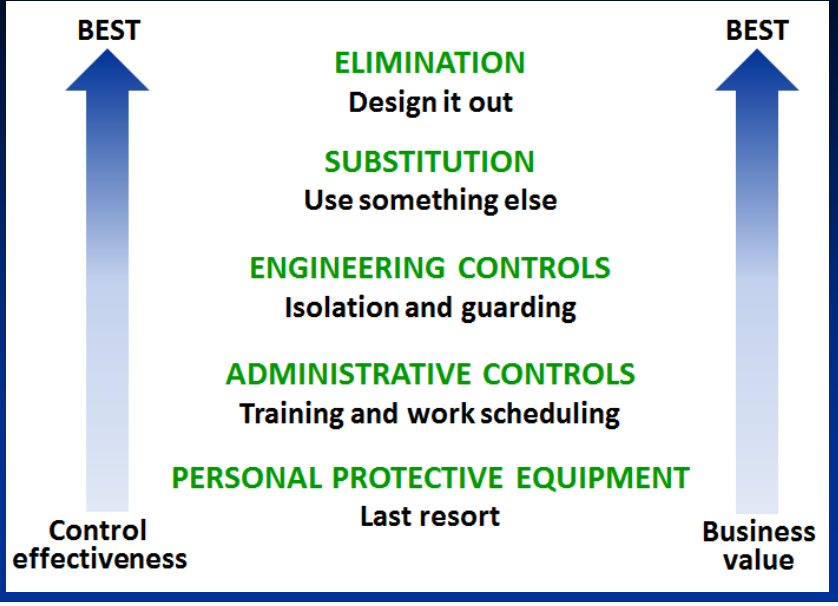
"Hierarchy of Controls"



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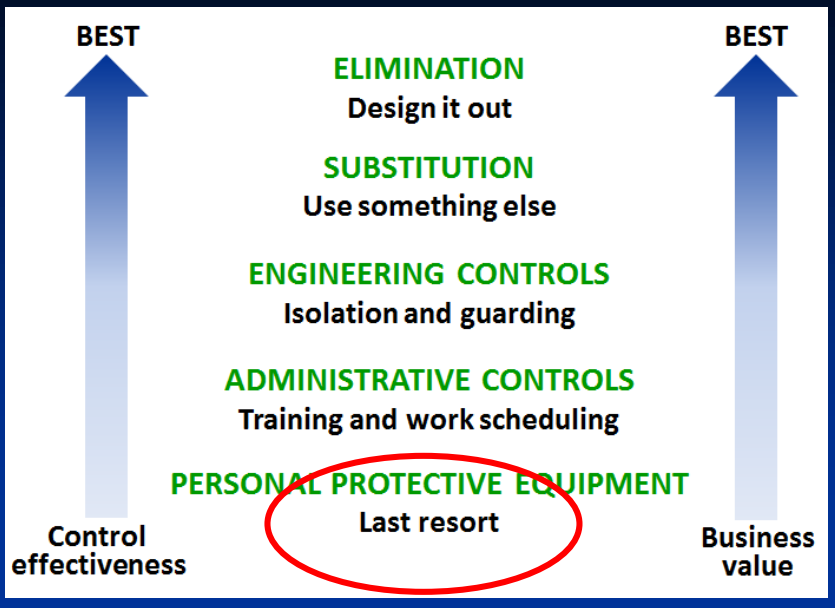
"Hierarchy of Controls"



How do we choose…?

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PPE rationale

- Targeted to susceptible body parts
- Optimized for real-world utility
  - Efficacy
  - Availability
  - Comfort
  - Ease and Safety

Acceptance
Adherence

Effectiveness

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PPE rationale

- Targeted to susceptible body parts
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Acceptance
Adherence

Effectiveness

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PPE rationale

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  - Ease and Safety

Acceptance
Adherence

Understanding + **Effectiveness**

Sustainability

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Essential Elements of Training

- Mandated
  - blood borne pathogens
- Onboarding
- Group-specific *(nursing, environmental services, respiratory therapy, physicians, radiology techs, dialysis techs, LPN…)*
- Assessing competency
- Targeted refresher training

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Essential Elements of Training

- Mandated
  - blood borne pathogens
- Onboarding
- Group-specific

Instilling risk-assessment

- Assessing competency
- Targeted refresher training

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Human *factors* vs Human *errors*

- People want to do a good job.

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Human *factors* vs Human *errors*

- People want to do a good job.

- Facility and equipment design
- Work processes
- Social networks

CDC

Human *factors* vs Human *errors*

- People want to do a good job.

- Facility and equipment design
- Work processes
- Social networks

- Adaptive systems using feedback

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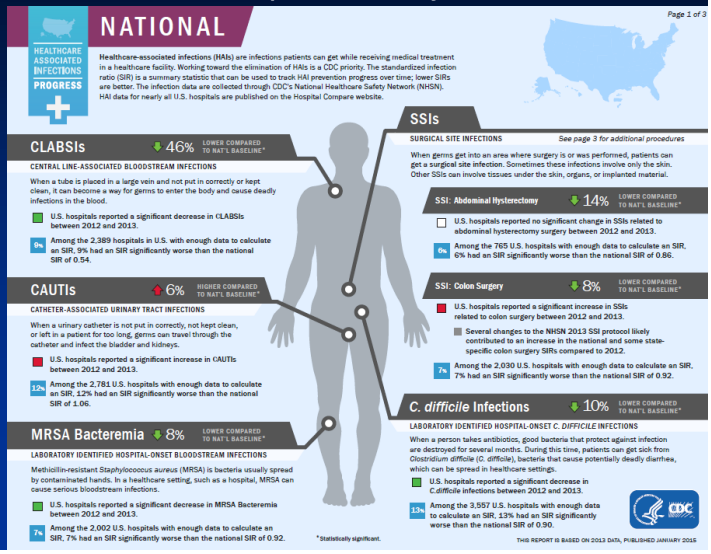
Healthcare-associated Infections

- 1 in 25 hospital patients
- > 700,000 HAIs in U.S acute care hospitals each year
- > 70,000 deaths



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Post-test assessment

1. Contact precautions are for infections spread by direct or indirect contact with patients or patient-care environment? (True or False)
2. All of the following are part of the disease transmission
   - A. Leave original host
   - B. Survive transit
   - C. Be delivered to host
   - D. Escape host defenses
   - E. All of the above

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Post-test assessment

3. PPE should be selected on which of the following:
   - A. Efficacy
   - B. Availability
   - C. Comfort
   - D. Ease and Safety
   - E. All of the Above
4. Standard Precautions are based on risk assessment, prevention of anticipated exposures, and combination of procedures and PPE? (True or False)

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Thank you

For more information please contact Centers for Disease Control and Prevention

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